



RTD LABORATORY REPORT

To: Tim Kersey
From: Justin Hughes
Date: 29 June 2011

Project Information (Siplast job file)

Project Name:	Casper Alcova Irrigation District
Project Location:	Casper, WY
Construction Date:	Completed January 1991
Area of Membrane Installation:	Approximately 2,000,000 square feet

Assembly

Membrane System

Ply:	Product Name:	Method of Application:
Finish	Teranap 431	Loose laid with torch welded seams

Project

Type:		
Irrigation Canal		

Sample Information


Three Teranap 431 geomembrane samples from the above referenced project were received by the RTD laboratory on February 5, 2011. The samples were submitted to evaluate the product's performance after 20 years in-place.



The samples were analyzed and the following data and conclusions were derived.



Observations

Sample Description: Membrane Layers and Application Methods	
Sample #A1	Finish Ply
	Teranap loose laid inside irrigation canal with heat welded seams. (Sample was taken from an area exposed to the elements.)
Sample #A2	Finish Ply
	Teranap loose laid inside irrigation canal with heat welded seams. (Sample was taken from an area exposed to the elements.)
Sample #B1	Finish Ply
	Teranap loose laid inside irrigation canal with heat welded seams. (Sample was taken from beneath a layer of sediment in the canal bed.)

Sample Description: Sample Size and Surface Appearance		
Sample #A1	Size: 590 in ² (4.1 ft ²)	Comments: Crazing was observed on the surface of the Teranap.
		

Sample Description: Sample Size and Surface Appearance		
Sample #A2	Size: 675 in ² (4.7 ft ²)	Comments: <u>Crazing</u> was observed on the surface of the Teranap.
		
Sample #B1	Size: 1279 in ² (8.9 ft ²)	Comments: No obvious signs of product or application issues were visible on the surface of the sample.
		

Sample Analysis: Microscope Surface Image

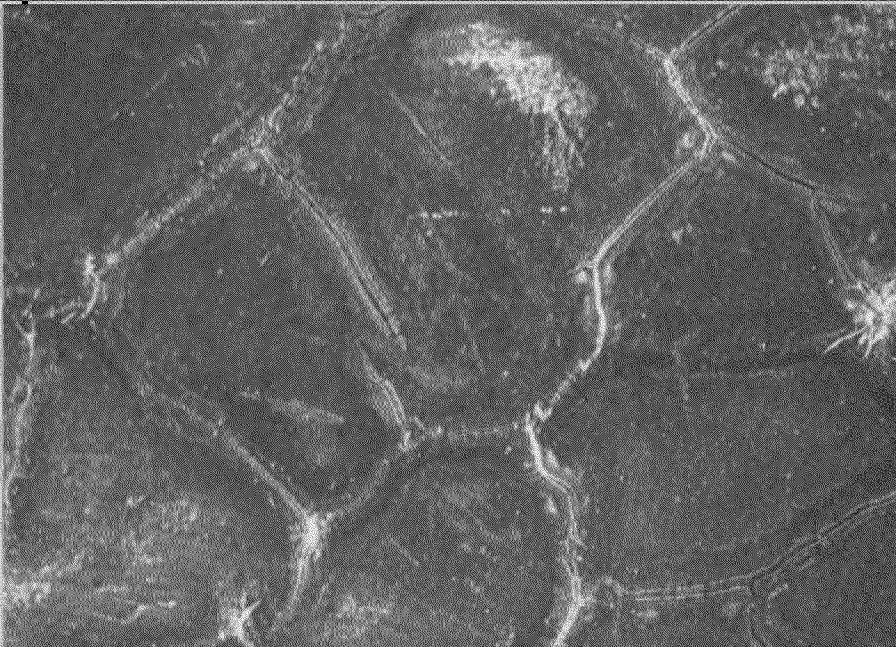
**Sample
#A1**

The microscope image indicates alligating in the surface of the Teranap.



**Sample
#A2**

The microscope image indicates alligating in the surface of the Teranap.



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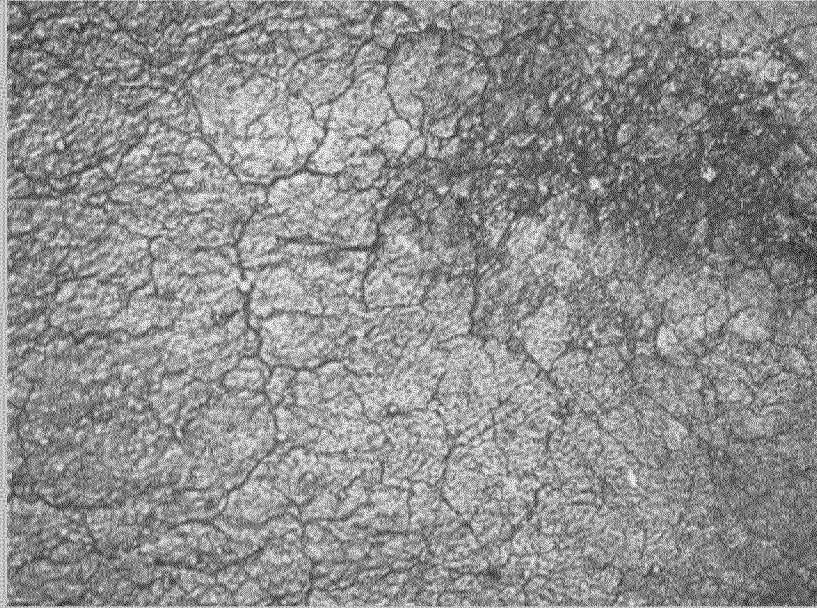


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Sample Analysis: Microscope Surface Image

Sample #
B1

The microscope image indicates checking (minor crazing) on the surface of the Teranap.



Sample Analysis: Microscope Measurement of the Crazing Channel Depth

The depth value depicted in the image is a single measurement. The average depth value reported is based on multiple measurements taken from the samples.

Sample #A1

Average Channel Depth
23 mils (0.58 mm)

Reinforcement Depth
40 mils (1.02 mm)



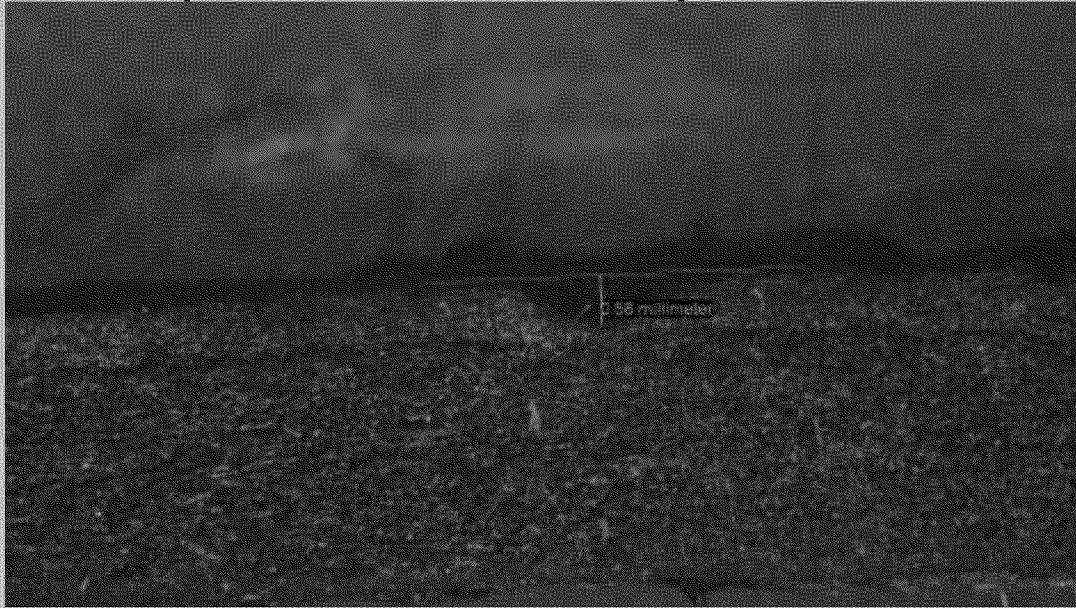
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Sample Analysis: Microscope Measurement of the Crazing Channel Depth

The depth value depicted in the image is a single measurement. The average depth value reported is based on multiple measurements taken from the samples.

Sample #A2	Average Channel Depth 21 mils (0.54 mm)	Reinforcement Depth 28 mils (0.70 mm)
		

Channels were too shallow to measure on sample #B1

Mechanical Properties

	Thickness mils (mm)	Average Peak Load lbf/in (kN/m)	Average Elongation @ Peak Load %	Low Temperature Flexibility °F (°C)
Sample #A1 (exposed)	161 (4.1)	161 (28.2)	62	21 (-6)
Sample #A2 (exposed)	161 (4.1)	160 (28.0)	65	21 (-6)
Sample #B1 (unexposed)	161 (4.1)	159 (28.0)	80	-11 (-24)

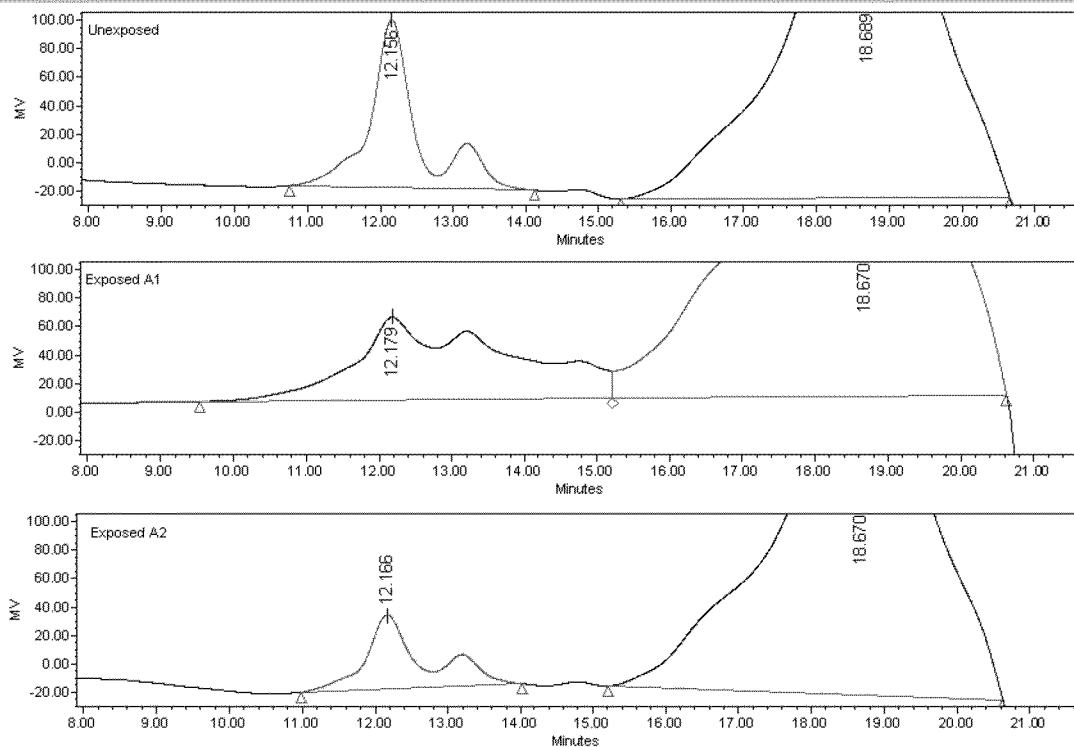
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Gel Permeation Chromatography (GPC) Analysis

Comments: The image compares the GPC curves for the individual samples. Based on the results there appears to be some polymer degradation in the exposed samples.



Jobsite Image

Comments: The image depicts the general condition of the irrigation canal. Note the exposed Teranap on the walls of the canal; this is the general area where Samples A1 and A2 were taken.



Comments: The image indicates where Sample B1 was extracted.



Conclusions

1. Samples A1 and A2 were taken from the upper wall of the irrigation canal where the membrane was directly exposed to UV light and the elements. These samples exhibited alligatoring on the surface. Microscope imagery indicated that the depth of the crazed SBS bitumen waterproofing did not penetrate to level of the reinforcement within the cross-section of the Teranap.
2. Sample B1 was extracted from beneath a layer of sediment in the bed of the canal. The sample had experienced limited, or no, direct exposure to UV. Due to the water and earth covering it is safe to say that this sample maintained a relatively constant and moderate temperature compared with the exposed samples A1 and A2.
3. Load-elongation tests were conducted and none of the samples experienced a loss of tensile strength compared to the specification values for new material. The elongation values also fell within the specification for new materials. Exposed samples A1 and A2 were 15-18% less than that of B1.
4. Low temperature flexibility tests showed a difference from the specimens taken from the exposed areas to those taken from the unexposed area; 21°F (-6°C) and -11°F (-24°C) respectively. There was little difference between the results of the B1 sample and those of new material.
5. GPC (gel permeation chromatography) analysis was performed on the SBS bitumen, and the exposed samples experienced a higher rate of polymer degradation than B1, however active (intact) SBS polymer remained in both A1 and A2.

